BULLETIN
PENNSYLVANIA DEPARTMENT OF AGRICULTURE
HARRISBURG, PA.

Vol. 12 April 1, 1929 No. 4

General Bulletin No. 473

The Japanese Beetle in Pennsylvania

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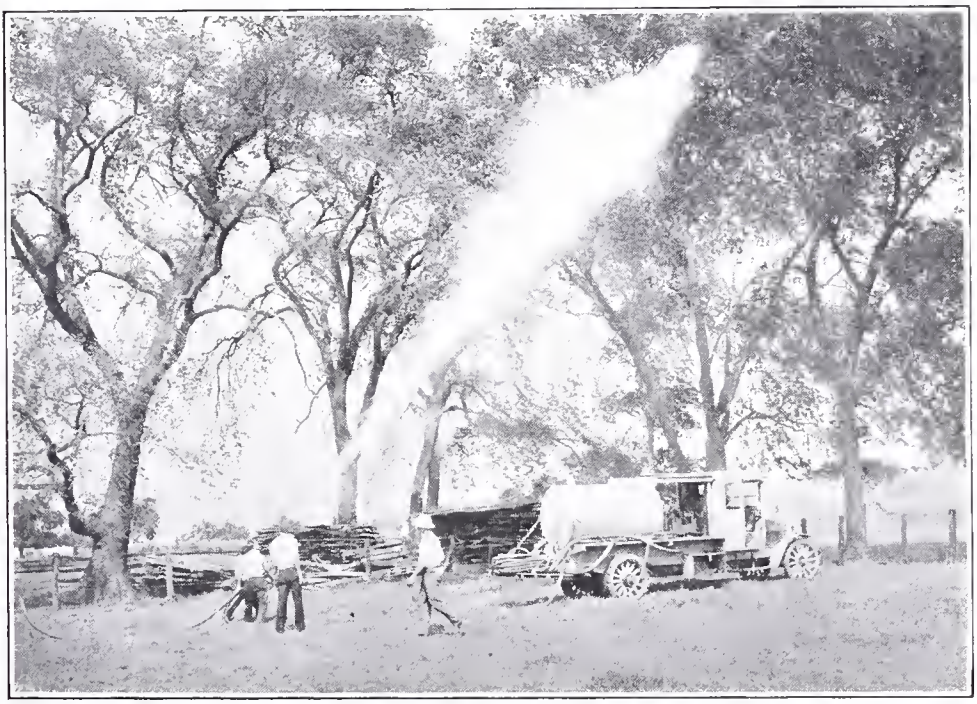

Spraying Elm Trees to Control Japanese Beetle

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Published monthly by direction of the Secretary. Entered as second class matter, March 22, 1918, at the Post Office at Harrisburg, Pa., under the Act of June 6, 1900. Acceptance for mailing at special rate of postage provided for in Section 1103, Act of October 3, 1917, authorized on June 29, 1918.

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Bureau of Plant Industry

The Japanese beetle (*Popillia japonica* Newman) is now (1929) known to occur more or less generally over the southeastern quarter of Pennsylvania. The infestation spread from a nursery in New Jersey near the Pennsylvania line, where in 1916 a few specimens were found. The known infested area in this country includes New Jersey and parts of Maryland, Delaware, New York, Connecticut, Massachusetts, District of Columbia and Virginia.

In the older areas of infestation the beetles occur in alarming numbers. Countless thousands may be seen on warm, bright days flying through the air and hundreds of grubs are found to the square yard of the grass-lands and lawns of such areas.

As is indicated by the common name, this insect is of Japanese origin and is thought to have been introduced into this country in shipments of nursery stock, probably azalea or iris. At first the true importance of the foreigner was not recognized but the rate with which it multiplied soon emphasized its possibility for doing damage.

DAMAGE DONE BY THE JAPANESE BEETLE

The beetle (adult) form feeds on a large number of plants including some important crops and foliage of shade trees. The list is a long one as may be seen from the following names taken from page nine of the U. S. Circular No. 363:

Indian corn, *Zea mays*
Canna, *Canna* sp.
Babylon weeping willow, *Salix babylonica.*
Willow, *Salix* spp.
Alder, *Alnus* sp.
European white birch, *Betula alba*
American chestnut, *Castanea dentata*
American elm, *Ulmus americana*
Smartweed, *Polygonum pennsylvanicum*
Plum, *Prunus domestica*
Cherry, *Prunus* sp.
Peach, *Amygdalus persica*
Rose, *Rosa* spp.
Highbush blackberry, *Rubus argutus*
Blackcap, *Rubus occidentalis*
Kerria, *Kerria japonica*
Soybean, *Soja max*
Horse-chestnut, *Aesculus hippocastanum*
Sassafras, *Sassafras variifolium*
Grape, *Vitis* spp.
Quince, *Cydonia oblonga*
Apple, *Malus sylvestris*
Virginia creeper, *Parthenocissus quinquefolia*
American elder, *Sambucus canadensis*
European cranberrybush, *Viburnum opulus*

American Linden, *Tilia americana*
Littleleaf European linden, *Tilia cordata*
Marshmallow, *Althaea officinalis*
Hollyhock, *Althaea rosea*
Evening-primrose, *Oenothera biennis*
Buttonbush, *Cephalanthus occidentalis*

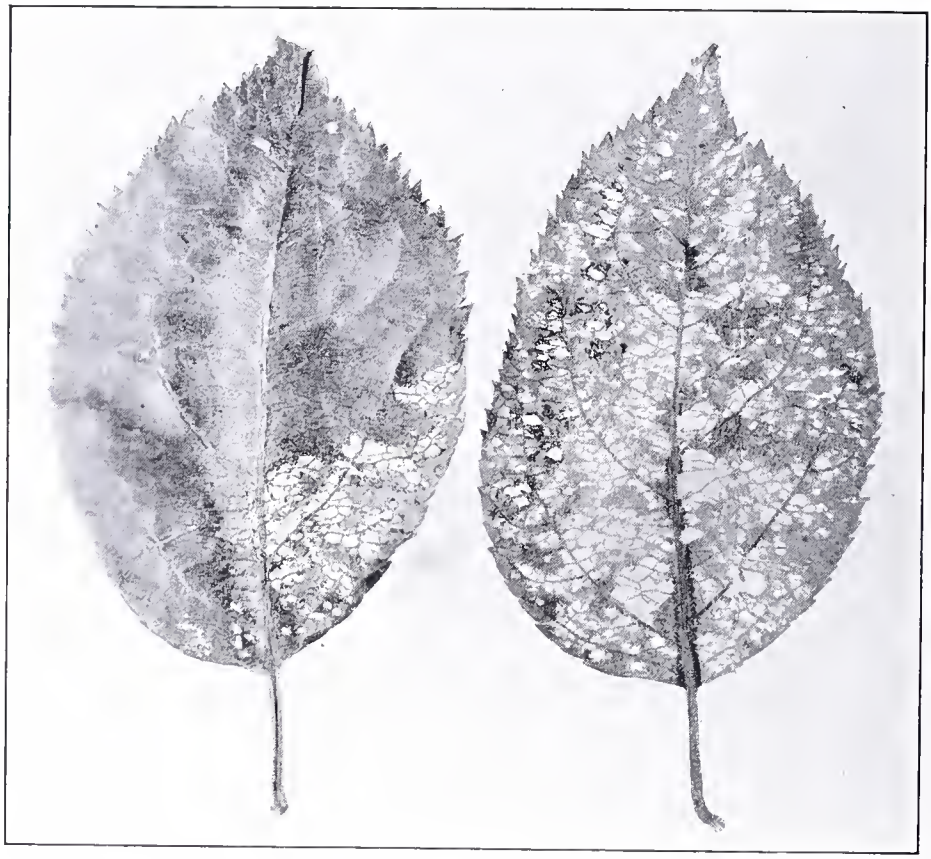

Fig. 1. Typical damage by Japanese Beetle to apple foliage.

These are reported as favorite food plants. The list contains the names of 154 other plants upon which the insect is known to feed.

The feeding beetles damage the plants by completely skeletonizing the leaves (See Figure 1) and feed on the flowers of certain plants. In regions of heavy infestation the leaves of the favorite food plants are made quite brown giving the appearance of fire damage (See Figure 2). Especially is this true of grape vines, roses, sweet cherries and certain shade trees. Some indication of the abundance of the beetles is shown by a catch recorded by the workers of the Federal Department of Agriculture in which 280 gallons of beetles were collected in one morning from 150 ten-year -old peach trees. Twenty-four hours later the pest seemed as numerous as before collection was made.

The beetles have a curious habit of collecting in large numbers on particular fruits, when feeding on apple or peach and of com-

pletely consuming the fruit so attacked. As many as 278 beetles have been collected from a single apple.

Grubs Also Destructive. The grub (larval) stage of the beetle is found in sod land (chiefly lawns and golf courses up to this time) where growth from the egg to the beetle takes place. The grubs feed on the roots of grasses, and in the area of heavy infestation severely damage, and at times completely kill, the grass in lawns and like places.

Fig. 2. Sweet cherry tree defoliated by Japanese Beetle.

DESCRIPTION OF THE BEETLE

The beetles are beautiful, brightly colored insects and are about a quarter of an inch in length and not quite so wide. They are broadly oval and rather stout. The color is bright metallic green except the wing covers which are copper brown. On the tip of the abdomen are two rather conspicuous spots composed of white hairs, on either side of which are smaller areas of the same color. These dots are characteristic markings of the Japanese beetle.

In the grub stage the insects are pale in color and when full grown and fully extended are about an inch in length. They always assume a curled-up position. They closely resemble many of our native white grub species, and only an experienced entomologist can distinguish them. The complete life history from egg to adult is shown graphically in Figure 3.

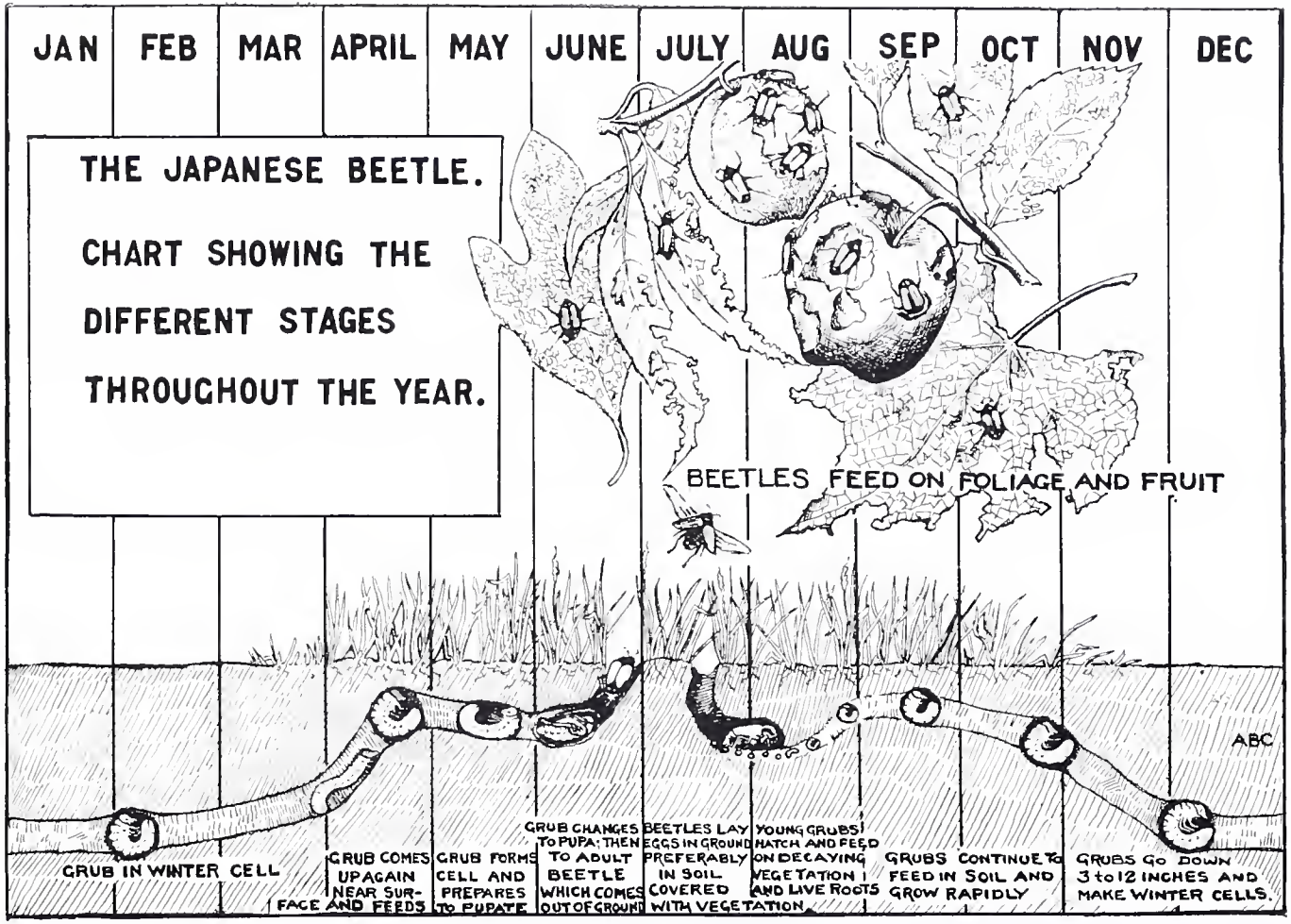

Fig. 3. Chart Showing Japanese Beetle Life History.

WAYS OF PREVENTING SPREAD

The Japanese beetle is dispersed or spread in two ways: Flight of the beetle, and by carriage in commerce. The flight spread is probably never more than five miles per year, and is difficult to control. The spread through commerce, however, may be checked and for this purpose the Federal and State Governments have established quarantines to regulate the movements of articles of commerce which may provide carriage for the beetle. Briefly the quarantine prohibits the movement of plants, plant products, soil, compost, manure and sand which may carry the beetle in its various stages.

Regulations governing the movement of plants such as farm produce, is aimed at the prevention of the spread of the beetle stage, while regulations governing the movement of nursery stock not free from soil, compost, soil and the like are to prevent the transportation of the grubs.

In Pennsylvania the restrictions on the movement of farm produce extends from June 15 to October 15, which period covers the season of the year when the beetles are flying.

Nursery stock with soil about the roots, compost, soil and the like originating in the area of infestation may serve as carriers of the grubs at any season of the year, hence the regulations governing the movement of such materials are enforced throughout the year. Inspection and certification of farm products are made under certain conditions during the period such produce is under quarantine, while nursery stock grown in infested soil, compost, soil and the like must be treated under supervision of an inspector before shipment may be lawfully made.

CONTROL MEASURES

Poison Sprays. Control measures for the beetle consists of spraying the foliage with a poison spray. The Federal Department of Agriculture through its research laboratory now located at Moorestown, N. J. has developed a coated form of arsenate of lead which when timely applied gives protection to plants liable to damage by the feeding beetles.

For shade trees use eight pounds of this coated arsenate of lead to 100 gallons of water. (Some manufacturers make slightly different recommendations and it is suggested that their recommendation be followed.) As is the case with most sprays this one must be made at the right time. It should begin at the time the first beetles appear. The spray must be thorough, entirely covering the foliage of the trees. In most seasons the spraying should be finished by the end of the first week in July.

The complete covering of the foliage with the poison spray cannot be over emphasized. In many instances this will call for special spray equipment. The operator should be equipped with a rig capable of producing sufficient pressure to send the spray to the tops of the highest trees. (See cover page.) Such equipment usually works at a pressure of 600 pounds.

For the protection of grape vines, fruit trees (except peaches), and vegetables, ordinary arsenate of lead, wheat flour and water should be used. The proportion is six pounds of powdered arsenate of lead, and four pounds of wheat flour to 100 gallons of water. In small amounts this would be five ounces of arsenate of lead, three ounces of wheat flour, to five gallons of water.

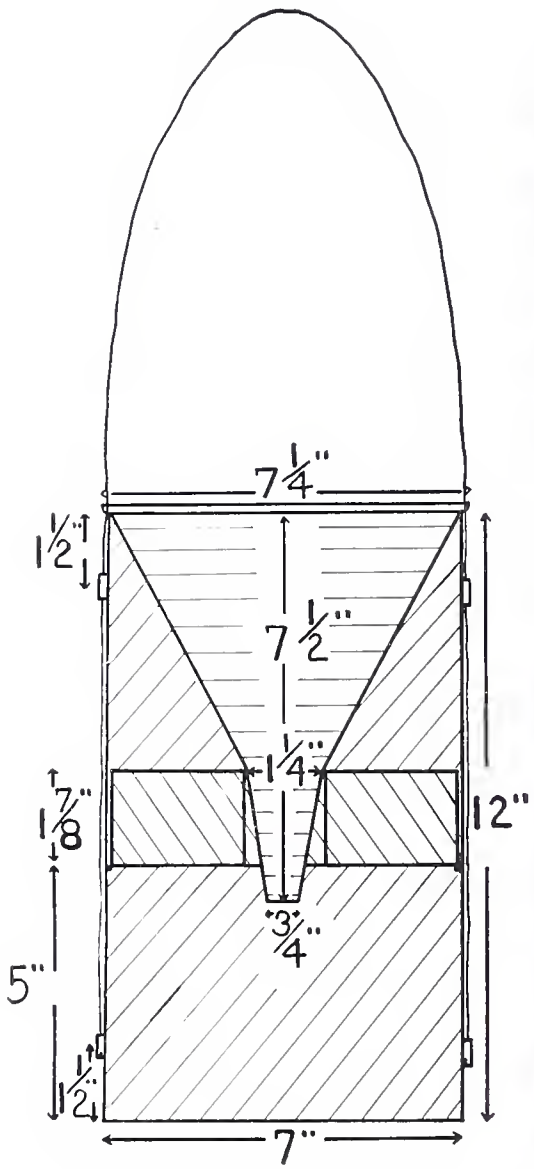

Fig. 4. Cross-Section of Trap Showing Dimensions.

Fig. 5. Trap in Operation.

For peach trees use three pounds of powdered arsenate of lead, two and one-half pounds of flour and ten pounds of hydrated lime to 100 gallons of water. In applying this spray to peach trees remember that it is not advisable to apply it later than four to six weeks before the fruit ripens. In the spraying of fruit trees complete protection requires that all of the foliage be thoroughly covered.

Contact Sprays for Japanese Beetle. When a large number of beetles occur on rare or extremely valuable plants, these may be killed off at once by thoroughly spraying the plants with pyrethrum-soap emulsion. This emulsion is now found on the market under various trade names, such as "Pyrethol," "Agripax," "Whiz Japanese Beetle Spray," "Green Tree," et. The dilution of this material is made according to the instructions on the container.

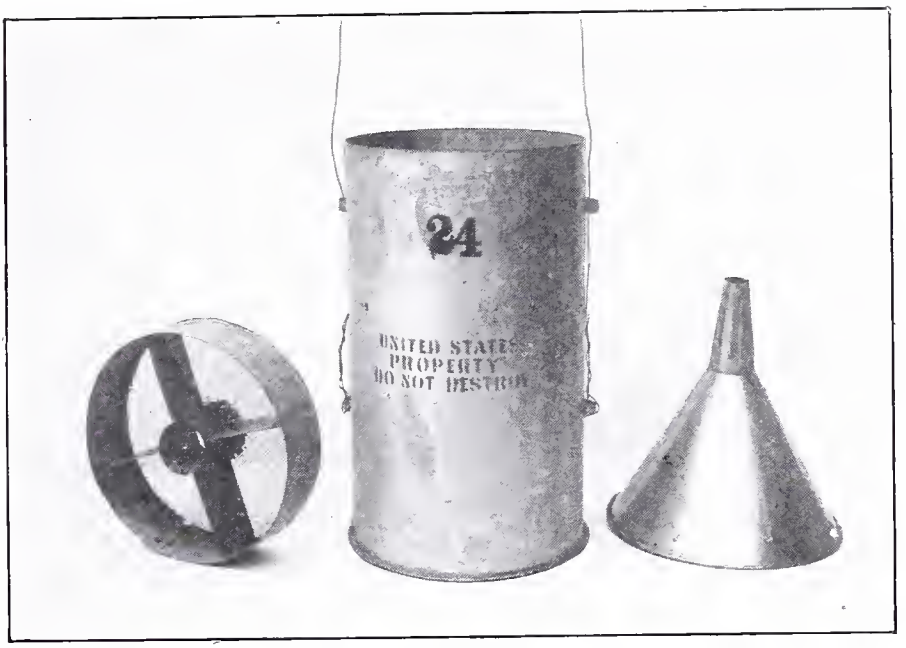

Fig. 6. Trap Unassembled, Showing Component Parts.

Traps for Beetle Control.* The use of traps is still somewhat in the experimental stage. During the last few years considerable work has been done by the Federal Department at Moorestown, N. J. in devising an efficient trap. One particular type has been successful in capturing large numbers of beetles and several companies are now manufacturing traps of this general type. These manufacturers have brought the traps to the attention of the public and interest has been aroused. Essentially, this type of trap consists of: (1) A straight sided pail-like vessel, seven inches in diameter and twelve inches tall, (2) A bait container slightly

*Figures 4, 5, and 6 were kindly loaned by the New Jersey Department of Agriculture.

smaller in diameter than the vessel, one and seven-eighths inches deep with the bottom closed with sixteen mesh copper screen and a central opening one and one-fourth inches in diameter. This is placed within the vessel with the bottom five inches from the bottom of the vessel. (3) To complete the trap a funnel seven and one-fourth inches in diameter and seven and one-half inches deep is placed with the point down in the vessel. (See Figures 4 and 6) The point also extends through the center of the bait container. The baited trap is hanged on a tree as shown in Figure 5. The formula for the bait according to New Jersey Circular No. 146 is as follows:

Geraniol (at least 58% pure)	1 teaspoonful (3.75 grams)
Eugenol (U. S. P.)	16 drops (0.375 grams)
Bran	1½ cups (75 grams)
Water	1 tablespoonful (13 c. c.)
Molasses	2½ tablespoonfuls (39 c. c.)
Glycerine (C P)	1½ teaspoonfuls (6 c. c.)

Fig. 7. Applying Carbon Bisulfide to a Lawn to Kill Japanese Beetle Grubs.

Total weight, approximately 15 grams, or one-third pound. This quantity is required for each trap. When these materials are purchased in large quantities the cost of the bait for a single trap is about three to four cents.

The following remarks on bait preparation are quoted from New Jersey Circular No. 146. "In preparing the bait, first, add the water and glycerine to the molasses and shake vigorously. Then pour the liquid slowly into the bran, stirring constantly. Add the

geraniol and eugenol and stir until the bran is thoroughly mixed with the liquid. The prepared bait should be kept in a closed container until used." The summary of this circular is as follows:

"(1) The use of traps is one efficient and inexpensive means of capturing large numbers of Japanese beetles. (2) Traps do not protect fruit, flowers or foliage from the attacks of the beetle."

Again we would state that we believe traps are still in the experimental stage, and their use therefore can not be recommended at this time.

Control of the Grubs in Grassland and Lawns. The grubs are controlled in two ways in lawns and like places: By the use of arsenate of lead mixed in the soil and by treating the soil with carbon bisulfide emulsion.

Fig. 8. Liberating Japanese Beetle Parasites, Flies brought from Japan.

Arsenate of Lead as a Grub Control. When used at the rate of 1,500 pounds to the acre (3½ pounds to 100 square feet) arsenate of lead has proven effective in grub control. Treatments are known to remain effective five years after the lead was applied. This treatment is reported as not unduly detrimental to the growth of the majority of grasses commonly used on golf greens and lawns.

The grasses which have been grown successfully in soil poisoned with arsenate of lead are: creeping bent, perennial rye grass, Ger-

man mixed bent, Chewing's fescue, sweet vernal grass, Kentucky blue grass and meadow fescue.

To treat an area with arsenate of lead proceed as follows: (1) Measure and calculate the exact area of the plot to be treated. (2) For small areas thoroughly mix three and one-half pounds of arsenate of lead (powdered) with one-half bushel of dry soil and scatter evenly over 100 square feet of surface. Even distribution is important and cannot be over-emphasized, since otherwise the result will be an uneven grub control. (3) For larger areas mix 175 pounds of arsenate of lead with one cubic yard (21½ bushels) of soil and apply over the surface of 5,000 square feet, remembering to make the distribution uniform over the entire area. (4) As soon as the mixture of soil and arsenate has been applied to the surface of the plot work in to a depth of three inches. In case of a lawn a hoe may be used for this purpose. A disc harrow followed by a spike tooth or other smoothing tool will be required on larger areas. The discing should be done in both ways across the plot. Seed as soon as the smoothing is finished.

Recently the Federal workers[1] have recommended the use of a topdressing made by mixing five pounds of arsenate of lead with one bushel of soil and applying to 1,000 square feet with a further topdressing of soil to make a quarter inch covering. Topdressings should be made in late summer and not later than September 15.

Carbon bisulfide emulsion. Carbon bisulfide emulsion consists essentially of seven parts of carbon bisulfide and three parts of an emulsifier. The emulsion is used at the rate of one quart to fifty gallons of water and this dilluted mixture is applied at the rate of three pints to the square foot of surface. In making the application one-half the required amount is applied and after a few minutes the remaining half is put on. Figure 7 shows the use of this material in treating infestations outside of the quarantined area. Notice the type of nozzle used in spreading the mixture over the ground. Carbon bisulfide emulsion may be prepared but the task is not an easy one and no doubt the most satisfactory method is to purchase the material from some reliable manufacturer who will guarantee to prepare it according to government formulae. The cost of such prepared emulsions in large lots is from fifteen to twenty cents per pound. Fall or spring treatment may be made. The ground temperature should be above 45°F. The dosage must be exact since an under-application will not kill the grub and an over-application may produce serious burning of the grasses.

(1) See "Golfdom" October 1927 to November 1928.

NATURAL ENEMIES OF THE JAPANESE BEETLE

Workers from U. S. Department of Agriculture are making a careful study of the beetle in Japan. The insect is not found especially abundant in that country, probably due to the intensive type of agriculture carried on by the Japanese and the presence of natural enemies of the beetle. A careful survey is being made of these natural enemies and such species as give promise of being helpful in controlling the beetle are being introduced into this country. Several species of insect parasites have been successfully established. These will not be enumerated, (For complete information see U. S. D. A. Department Bulletin 1429), but the most promising species are certain flies and small wasp-like insects; and it is believed that before long they will become an important factor in beetle control. Figure 8 shows the liberation of parasites at Harrisburg during the summer 1928.

Some Birds Known to Feed on Japanese Beetles. According to the Federal Department of Agriculture the purple grackle and starling are probably our most important bird enemies of the beetle. Remnants of beetles have also been taken from the stomachs of the king bird, cardinal, meadow lark, cat bird, quail, great crested fly catcher, crow, red winged black bird, English sparrow, vesper sparrow, brown thrasher, wood thrush and the robin. A pair of English pheasants showed a great liking for both dead and living Japanese beetles.

As much as 22 per cent of the stomach contents of individual toads examined were found to consist of beetles.

No record has been made of the feeding of skunks on the Japanese beetle, but it seems safe to assume that both the beetles and the grubs would be devoured by these animals, since many native species belonging to the same group are eagerly sought by the skunk.

SUMMARY

The Japanese beetle is now firmly established in Pennsylvania and the people of the Commonwealth must learn to live with it. Quarantine regulations are established to prevent long distance spread, thus delaying the infestation of counties outside of the known area of infestation. Natural enemies now being introduced from Japan give much promise in control. The coating of foliage with arsenate of lead gives good protection to plants, while the grubs may be killed in lawns and golf courses by using arsenate of lead or carbon bisulfide emulsion.

Further information will be gladly furnished by either the U. S. Japanese Beetle Laboratory, Moorestown, N. J., or the Bureau of Plant Industry, Pennsylvania Department of Agriculture, Harrisburg, Pa.